



DRWM Rec'd MAR 08 2011



Prepared for:  
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## 2010 Annual Summary Leachate/Ground Water Monitoring Report

Former Abbott Property, Wichita, Kansas  
EPA I.D. NO: KSD981495567

March 7, 2011

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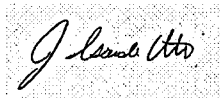
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**INTRODUCTION**

This 2010 Annual Summary Leachate/Ground Water Monitoring Report was prepared as part of and in accordance with Section 6.1 of the Post-Closure Plan (PCP) for the Former Evaporation Lagoon (FEL) on the Abbott property (the Site), located south of Wichita, Kansas, on behalf of Abbott Laboratories (Abbott). The Site location is shown on Figure 1 and Site layout is shown in Figure 2. All monitoring activities were completed in accordance with the PCP, Sampling and Analysis Plan (SAP) and Operations and Maintenance Plan (O&M Plan) for the FEL closure.

**HISTORICAL OPERATIONS**

Abbott commenced operations at the site in 1960. The operations originally included the production of cyclohexylamine used in the production of an artificial sweetener. Facility operations later included the production of additional amine-based intermediate products that were used in the production of textiles, rubber, plastics, adhesives and pharmaceuticals.

Groundwater contamination was first discovered at the site in 1977 and first studied in detail in 1979. In 1979, Abbott began operating a voluntary extraction well system to remediate the groundwater below the facility.

Abbott sold the facility to Air Products and Chemicals, Inc. in 1985, but retained ownership of Solid Waste Evaporation Lagoon (FEL), as well as the evaporation pond, drum storage area and underground deep injection well (see Figure 2). The lagoon was constructed in 1980. Operation of the evaporation lagoon system was managed essentially as a "closed loop" treatment system. That is, a thin layer of wastewater was allowed to evaporate. Un-evaporated wastewater gradually infiltrated through the liner and accumulated in the leachate collection system sump. Periodically the contents of this sump were pumped back into the lagoon and the evaporation/collection cycle continued.

Abbott initiated closure of the evaporation lagoon after it ceased operations at the property in 1985. Closure activities were approved by the Kansas Department of Health and Environment (KDHE). In May 1986, the remaining standing liquid in the evaporation lagoon was removed and disposed of on-site into the deep injection well.

Although the former evaporation lagoon is technically closed, the leachate collection system continues to operate and the collected effluent is stored in an aboveground storage tank at the site. In 2005, Abbott re-constructed the cap as a formal engineered cap to eliminate leachate generation; Abbott used KDHE regulations pertaining to municipal solid waste landfill standards (K.A.R. 28-290-121) as a guideline for the lagoon cap redesign. The redesign and construction provided final slopes, which support vegetation and minimize erosion. All slopes were designed to drain runoff away from the cover and prevent ponding. In addition, the cap design eliminates percolation through the cap. Currently, the cap is covered on all sides and top with grass.

## **SITE SETTINGS AND GEOLOGY**

The Site lies within the Arkansas River lowlands section of the Central Lowlands Physiographic Province. The topography is characterized by the extreme flatness of a broad river valley and the gently rolling slopes rising to the uplands adjacent to the valley. Ground surface elevations range from about 1,300 feet to about 1,320 feet above mean sea level across the site.

The uppermost bedrock unit below the FEL is the Wellington Formation. The Wellington consists of mainly calcareous gray and blue-gray shale containing thick beds of salt and thin beds of gypsum, anhydride and impure limestone. Gypsum beds are most common in the lower part of the formation. The Hutchinson Salt Member lies in the middle of the Wellington Formation but has been removed by solution in the eastern two thirds of Sedgwick County, and partially removed in the area beneath the facility. The Hutchinson Salt Member was not encountered during the bedrock coring performed by URS during the 1992 field investigation portion of the RCRA Remedial Facility Investigation. Within five to ten miles west of the facility, the Hutchinson Salt Member thickens to near its uneroded thickness of approximately 350 feet. The Wellington Formation is approximately 400 feet thick beneath the facility, and ranges in thickness from 80 feet near the east county line, where it is partly eroded, to 550 feet near the west county line, where the entire thickness of salt and gypsum are present.

The Wellington formation is considered the lowest confining layer for the unconsolidated deposits underneath the facility. These unconsolidated deposits are the major water-producing units in central Sedgwick County. Approximately 100 to 150 feet of the Pleistocene to Recent deposits overlie the Wellington Formation in the vicinity of the facility. The Pliocene-Pleistocene Ogallala Formation has not been identified in the southern part of Sedgwick County, including the facility. The lowermost unconsolidated deposits beneath the facility are the Lower Pleistocene, undifferentiated Nebraskan and Kansan deposits that are overlain by Illinoisan terrace deposits.

## **GROUNDWATER AND MONITORING WELL NETWORK**

The unconsolidated deposits that overlie the Wellington Shale comprise the uppermost aquifer at the facility. The Wellington Shale acts as a lower confining layer for the aquifer. Some water is available from the weathered portion of the Wellington, but it tends to be highly mineralized because of the evaporites present in the formation. The productivity of wells completed in the Wellington Formation tends to be low. Because of the low

yield and generally poor water quality, most of the wells in the vicinity of the facility do not generally penetrate far into the Wellington Formation (KDHE, 1988).

Although the unconsolidated deposits can generally be differentiated into separate sand and clay units, most wells completed into these deposits are not screened in any single stratigraphic interval. The water obtained from the formations is usually high in dissolved solids, but is suitable for most purposes. The water from the lowest portions of the aquifer may contain undesirable amounts of dissolved salt and leached minerals from the Wellington in the area of the Site.

Regional groundwater flow is generally to the east-southeast, but localized, transient pumping for irrigation, water supply and extraction wells disrupt the regional pattern. The aquifer at the Site is generally comprised of two layers of higher and lower permeability, corresponding to sand and clay stratifications.

Boring logs show that the geology underlying the area around the Site is comprised of approximately 90 to 120 feet of alluvial deposits that consist of interbedded clays, silts, sands and gravel that exhibit lateral and vertical variations in thickness and grain size over the study area. The sand layers that occur in the alluvial deposits have been given the designations S1 (deepest sand unit) to S4 (shallowest sand unit). Based on the soil boring logs for the Site, the sand units are not laterally continuous layers of the same lithology but represent differing depositional environments. Assuming that the sand unit S2 at MW-4S is the same sand unit S2 at MW-102S may not be correct.

Using the designations as represented throughout the area, the sand units are at the following approximate depths:

- S4 – 20 to 30 feet below ground surface (bgs);
- S3 – 40 to 55 feet bgs;
- S2 – 65 to 85 feet bgs; and
- S1 – 90 feet bgs to the Wellington Shale interface.

Monitoring well clusters have been installed by Abbott and others to monitor the groundwater because of the multi-layered aquifer. The current FEL groundwater monitoring network incorporates four existing well clusters: MW-4S, MW-4D, MW-8S and MW-8D which were installed in 1979, MW-16S and MW-16D which were installed in 1981, and MW-102S and MW-102D which were installed in 1983. According to historical Abbott documents and boring logs, the shallow (S) wells MW-4S and MW-16S are screened in the S2 unit, MW-8S is screened in the S2-S3 units and MW-102S is screened in the S-3 unit. The deep (D) wells are screened in the



S1 unit directly above the Wellington Shale. Construction details and depths are summarized in the boring/well logs for each of these monitoring wells that are provided in Appendix 2 of the SAP.

In accordance with Sections 3.2 and 6.1 of the PCP, leachate monitoring was completed on a quarterly and groundwater monitoring was completed on a semi-annual basis, respectively. The following subsections summarize the activities and results of this monitoring.

## 3.1

**FIELD ACTIVITIES***3.1.1 Abbott Ground Water Monitoring*

Prior to purging and sampling activities, ground water elevations were measured at monitoring wells in and around the Site during the May 12 and October 11, 2010 semi-annual groundwater monitoring sampling events. Depth to ground water was measured at each monitoring well and recorded to the nearest 0.01 foot. A summary of the ground water elevations measured at the Site during each monitoring event in 2010 is presented in Table 1. Groundwater elevations over the 2010 monitoring period have remained at approximately the same level across the Site when compared to the 2009 groundwater levels. All static groundwater levels were measured within a 24-hour period prior to purging and sampling as indicated in Appendix A. Utilizing this water level information, potentiometric surface maps for each quarter / event were prepared to depict groundwater flow in the S1 and S2. The S2 maps are provided as Figures 3 and 4 (MW-04S, MW-16S, MW-08S, MW-102S). Figures 5 and 6 depict groundwater flow in the S1.

As shown in Figure 3 through 6, May and October 2010 data showed groundwater flow to be towards the southeast, away from the Site. Vertical gradient generally fluctuated in direction in each well pair with an upward gradient in one monitoring period and a downward gradient in the next monitoring period, showing no apparent trend or preference for vertical gradient. Difference in water levels between well pairs were generally observed to be less than 0.3 feet, with the exception of MW-102 which averaged 0.62 feet in elevation. Horizontal gradients across the site fluctuated from approximately 0.0025 inches/foot in May to 0.0020 inches/foot in October.

Historical ground water flow at the Site has been observed to the north when pumping is occurring, and to the east /southeast when no pumping occurs, but influence from any pumping activities were not observed in 2010. Hydraulic conductivity and transmissivity values range from 80 to 172 ft/day and 600 to 1,278 ft<sup>2</sup>, respectively as derived from pumping test performed by Woodward Clyde in 1991.

All eight monitoring wells were purged during the May and October sampling events using low flow techniques using dedicated bladder pumps permanently installed in the wells, with the exception of MW-8S and MW-102S which were purged and sampled using a portable bladder pump. Purge water was contained in 5-gallon containers until emptied into the aboveground holding tank adjacent to the injection well at the Site. Purge water was withdrawn at rates of less than 500 milliliters (ml) per minute prior to sampling and the monitoring wells were considered stabilized when three successive field measurements, taken 3 minutes apart, fell within the following criteria:

- $\pm 0.1$  for pH
- $\pm 3\%$  for specific conductivity
- $\pm 10\%$  for dissolved oxygen
- $\pm 10\%$  for turbidity

Immediately following purging, ground water samples were collected in accordance with Section 5.4.4 of the SAP. Specifically, each sample was placed in the appropriate laboratory-supplied and labeled sample containers, and all samples to be analyzed for dissolved metals were field-filtered prior to placement into the laboratory-supplied plastic sample containers. Upon collection, all sample containers were placed in a sample cooler on wet ice. Sample coolers were secured under chain-of-custody procedures and then shipped under express delivery to the laboratory for analysis. Field measurements, notes and other data collected during all of the groundwater monitoring in 2010, are provided on the Groundwater Sampling Logs provided in Appendix A.

### *3.1.2 Leachate Monitoring*

Leachate monitoring in accordance with section 3.2.1 of the PCP was partially completed during 2010. Leachate volume monitoring was completed and showed only approximately less than 1-gallon of leachate was generated and able to be collected over 2010. As a result, leachate sampling and analysis could not be completed as there was never enough volume of leachate generated to actually collect enough sample for analysis. Leachate Sampling Logs for each monitoring effort are provided in Appendix A.

KDHE-approved improvements to the sump were made in October and December of 2009, to insure that all leachate generated is collected and contained discreetly and separately from any perched water that collects in the sump. Leachate monitoring will continue in accordance with section 3.2.1 of the PCP in 2011, assuming enough leachate is generated to properly collect a sample and analyze within analytical holding times.

## 3.2 SAMPLE ANALYSIS AND RESULTS

### 3.2.1 *Abbott Ground Water Samples*

Eight ground water monitoring wells were sampled for chemical quality on a semi-annual basis during the May and October events. The wells sampled were: MW-04S, MW-04D, MW-08S, MW-08D, MW-16S, MW-16D, MW-102S and MW-102D. All ground water samples were collected in accordance with Section 5.4.4 of the SAP, and were then submitted to the Continental Analytical Services, Inc. (CAS) laboratory (KDHE certification E-10146) located in Salina, Kansas for analysis of the parameters listed in Table 2. Each of the parameters in Table 2 was analyzed for during each semi-annual event.

Ground water sample analytical results for each event are detailed in Table 3 and the Laboratory Analytical Data Report and Chain-of-Custody forms for each event are provided in Appendix B. As seen in Table 3, arsenic, n-methylcyclohexylamine, o-toluidine, and dicyclohexylamine were detected in a limited number of samples. However, arsenic was the only constituent detected in a concentration exceeding its respective applicable and established standard. Specifically, arsenic was detected in samples collected from MW-16S and MW-08D in concentrations exceeding its respective US EPA MCL and KDHE-approved Tier 2 Risk-Based Standard (RSK) of 0.010 mg/l for the non-residential scenario groundwater pathway published in Appendix A in the Risk-Based Standards for Kansas RSK Manual – 5<sup>th</sup> Version October 2010. Specific exceedances are highlighted in Table 3 and shown on Figure 7 and Figure 8. Exceedances observed in the S2 and S1 sand intervals as shown by detected levels of arsenic in the well clusters MW-16 and MW-08 indicate limited vertical extent of contamination observed in MW-08 when compared to the 2009 analytical data. Horizontal extent is indicated in Figures 7 and 8 showing contamination greatest around MW-08D and decreasing towards MW-16S.

It was noted that March 2009's analysis of N-nitrosodi-N-butylamine samples resulted in elevated detection levels. During the September 2009 period, N-nitrosodi-N-butylamine was analyzed for using the same laboratory method as March 2009 method as well as a modified analytical method identified by Abbott and CAS (N-nitrosodi-N-butylamine-116 via USEPA Method 8270c) to lower the detection levels to less than 2.5 ug/L. Analytical results under both methods are reported in Table 3. As seen in Table 3, N-nitrosodi-N-butylamine was not detected under either method.

No contaminants were detected in any trip blank sample, indicating that cross contamination from volatile constituents did not occur while the samples were in transit to the laboratory. Furthermore, duplicate sample

analytical results were within acceptable levels when compared to the non-duplicate sample from the same well, indicating consistent laboratory QA/QC practices during the analysis. All samples collected in 2010 were analyzed with their respective holding times and matrix spike and matrix spike duplicates were not observed to be out of predicted ranges as shown in the May and October laboratory reports.

Abbott has developed and submitted site-specific Tier 2 RSKs for each of the parameters listed in Table and analyzed for by Abbott. Once finalized and agreed upon by KDHE, these site-specific RSKs will then be used as standards of comparison for the site and closure. In addition to Table 3, the analytical results have been added to the respective Contaminant Sampling and Detection Summary Tables that were presented in Appendix 7 of the PCP, for a comparison to historical data. These revised Contaminant sampling and Detection Summary Tables are provided in Appendix C. By comparing the 2010 results to the historical results, it is seen that o-toluidine, n-methylcyclohexylamine, dicyclohexylamine, and arsenic have decreased in concentrations and the remaining analytes were not detected above method detection limits.

No statistical analysis was performed on the constituent over the MCL/KDHE RSK level (arsenic) due to a limited number of sampling periods (March and September 2009 and May and October 2010 sampling events). A fifth monitoring point is generally accepted to be a minimally sufficient number of events when a limited statistical analysis such as a Mann-Kendall or Sen's Slope analysis can be applied to statistically evaluate any trend.

Based upon previously calculated hydraulic conductivity, the estimated rate of contaminant migration is expected to be 80 to 172 ft/day, but transport could be significantly retarded when contaminants encounter confining layers such as clay which are known to pinch out the sand layers that the monitoring well network is reported to be screened across.

### 3.2.2 *OxyChem Groundwater Samples*

As indicated in Section 6.1 of the PCP, Abbott was also to provide a table summarizing the results of OxyChem's monitoring of Abbott wells for the following:

- Dichloromethane (Methylene chloride)
- 1,2 Dichloroethane
- Trichloromethane
- Trichloroethylene
- Tetrachloroethylene
- Tetrachloromethane (Carbon tetrachloride)



- Vinyl chloride
- Benzene

A summary of these results, as provided by OxyChem is provided in Appendix D.

### 3.2.3

#### *Leachate Samples*

As indicated in Section 3.1.2, there was never enough volume of leachate generated to actually collect and analyze the leachate during 2010, as planned.

#### **LAGOON CAP, LEACHATE COLLECTION SYSTEM AND MONITORING WELL INSPECTIONS**

The Lagoon cap, leachate collection system and monitoring wells were inspected in accordance with Sections 4.0 of the PCP, 5.4.2 and 7.0 of the SAP and the O&M Plan during each of the field monitoring events in May and October and during separate mobilizations in March and August. Leachate System/Monitoring Well and Lagoon Cap Inspection Logs are provided in Appendix E.

Overall, lagoon cap integrity inspections confirm drainage at the cap was thorough and leaves/vegetation buildup along the fence line was minimal. The cap is covered with native grass and revegetated with no stressed vegetation or barren areas observed. The cap was in overall good condition.

The leachate collection system sump and building appeared to be in good condition. No visual evidence of significant cracks or non-working order equipment was observed at the sump. However, perched water from precipitation was observed periodically to infiltrate into the sump. As monitoring has confirmed nominal leachate generation, this liquid buildup in the sump was confirmed to be perched water infiltrating into the sump as its bottom/wall juncture is not tight. However, this condition is not concluded to be a concern as the perched water is not a concern (as it is generated during precipitation, and a sound and contained discrete leachate collection container was installed in the sump under the approval of KDHE. Post-installation frequent inspection has confirmed that the discrete leachate collection container is effective in collecting and containing just the leachate.

**UNANTICIPATED EVENTS**

On September 2, 2010, Air Products and Chemicals, Inc. (Air Products) reported a release from their neighboring facility of approximately 10 pounds of material containing alkylated amine as a aerosol from a location between the MW-101 and MW-16 well clusters. Impacted gravel and soils were removed by Air Products from the spill site and contaminated equipment and structures were cleaned. This incident was reported to the Kansas Department of Health and Environment (KDHE) as a spill and the investigation and cleanup activities were completed by Air Products. The spill event is still awaiting a "no further action" letter from KDHE as of December 23, 2010

*CONCLUSION*

During the PCP monitoring and inspections through 2010, it was confirmed that the former evaporation lagoon cap and leachate collection system, and associated PCP groundwater monitoring system are in good condition, effective, and meet their intent of controlling and managing any leachate generated through the lagoon, and monitoring of the underlying groundwater at, and risk posed by, the site. Furthermore, based upon the results through 2010, the corrective action post-closure monitoring conducted is appropriate to confirm the extent and nature of groundwater contamination from the former evaporation lagoon, and that the extent of contamination does not pose an unacceptable risk to human health and the environment.